FRD Activities Report
July 2000

Research Programs

Refractive Turbulence Research

Our Refractive Turbulence research supports the Air Force's need to understand anomalous atmospheric effects of refractive gradients. Previous efforts deployed three BAT probes on the Egrett to measure turbulence at 50,000 ft. These efforts demonstrated the need for higher temperature resolution and frequency response in low turbulence often encountered. This month, we report on our efforts to develop and test two new high accuracy temperature sensors. These new sensors will fly in the Refractive Turbulence Study 2000 (RTS00) starting August 1.

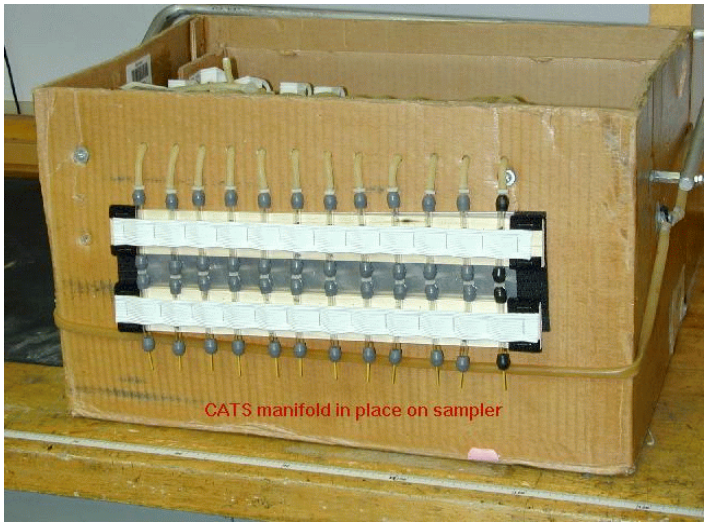
Figure 1. LongEZ N3R with the FUFT and FUST probes. From left are Drs. Tim Crawford, Owen Coté, Kris Haman and Jeff French

For the RTS00 instrument test platform, LongEZ N3R was modified for high-altitude operation and to carry the new instrumentation. The high-altitude modifications follow those of LongEZ (N57JP) which holds the C-1.a weight class altitude record at 35,000 ft. Even without modifications, LongEZ's are noted for their range, speed and altitude performance. But to operate at 25,000 ft while carrying the instrumentation weight and associated drag of the external probes, both engine and airframe modifications were required. Installation of the new temperature probes required modification of the BAT Probe/LongEZ configuration. Figure 1 illustrates the installation of these probes. Left of the BAT probe, with its red protective cover, is the Ultra Fast Temperature (UFT) Sensor. To the right is FRD's new Fast Ultra Sensitive Temperature (FUST) probe.

Dr. Haman's (University of Warsaw) UFT probe uses an exposed 2.5 µm cold wire that responds to 1 KHz temperature fluctuations. Because of its very small diameter sensor (8 times smaller than a human hair), it is easy damaged and requires protection that is removed in flight. Even so, damage is still likely. FRD's FUST probe uses a 25µm thermocouple and can resolve 0.005°C temperature fluctuations at 100 Hz. The FUST sensing element is robust, alleviates noise due to wire strain and its housing is designed to be speed and flow angle independent. Comparisons between the probes under various conditions a high altitudes will shed light on the necessity for both high resolution and high frequency measurements. (Tim.Crawford@noaa.gov, Jeff French, Randy Johnson, Owen Cote and Kris Haman)

VTMX/CBNP 2000

The pace of preparations for VTMX/CBNP 2000 is hitting a near-fever pitch. With the field deployment to Salt Lake City scheduled to be complete by 30 September, work is proceeding along several fronts. The design and prototype construction of a CATS manifold to interface with the FRD Whole Air Bag Sampler has been completed. This manifold will permit the simultaneous collection of both perflourocarbon and SF_6 tracer gases. Forty of FRD's samplers will be modified to accommodate the CATS manifold. Full-scale construction has begun on the CATS manifolds.


CATS manifold in place on sampler

All 130 of FRD's Whole Air Bag Samplers will be deployed during the field study. On close inspection of the samplers, it was discovered that the 12-year old cases were in serious need of replacement. As a result, new containers were constructed from existing materials and the sampling pumps and electronics are currently being removed from the old containers for installation in the new containers. New sample inlet tubing and bungy cords are also being installed on the new containers. Once the transfer process has been completed, the electronics and pumps will be subjected to a series of tests to assure proper operation prior to field deployment. Cleaning of the Whole Air Bag Sampler cartridges has also begun.

All 4 of FRD's SF_6 gas chromatographs, which are used for the analysis of SF_6 samples collected by the Whole Air Bag Samplers, have been brought back to life from a cold shut-down status. Three have received a clean bill of health, while the 4th GC awaits a new sample valve.


Debbie Lacroix, new FRD employee, with FRD's SF_6 gas chromatographs.

Work is nearing completion on the new and improved FRD mobile SF_6 analyzers. The analyzers have now been redesigned and built to be installed in a vehicle as small as a compact car. It is also possible to install them on 4-wheelers for detection of SF_6 in very rugged terrain. The big and bulky nitrogen and hydrogen tanks have been replaced with small and lightweight tanks. These are also must safer to handle and transport. The calibration system has been completely revamped to allow multiple

calibration points of identical concentrations of SF_6. With the termination of GPS selective availability, smaller and cheaper GPS systems with the same accuracy and resolution of the old and bulky DGPS systems have been included in the design.

Preparations will begin this month to support three other VTMX/CBNP tasks. These tasks are: 1) SF_6 line and point source releases, 2) deployment and operation of 2 3-D sonic anemometers, and 3) deployment and operation of a radar profiler, sodar, and RASS system. (Kirk.Clawson@noaa.gov and staff)

Central California Ozone Study (CCOS)

Data acquisition continues by the nine towers deployed for the Central California Ozone Study (CCOS). Quality control screening efforts have shown that these tower systems are working exceptionally well. One interesting note, however, was that the Campbell Scientific CR-10 data logger used for the Piedras Blancas Lighthouse (PBL) meteorology tower was accidently reprogrammed by the Desert Research Institute (DRI). Two phone lines were installed at PBL prior to the start of the study. One line was assigned to FRD for the meteorology tower while the other was assigned to DRI for their air quality sensors. By coincidence, DRI is also using Campbell Scientific CR-10 data loggers. A DRI scientist mistakenly dialed the wrong phone number and downloaded their program into the FRD data logger. As a result, erroneous data was being logged by the PBL tower. This problem was flagged within 24 hours and the CR-10 was properly reprogrammed. Because this little mishap, all nine CCOS data loggers have been password-protected to prevent this from occurring again.

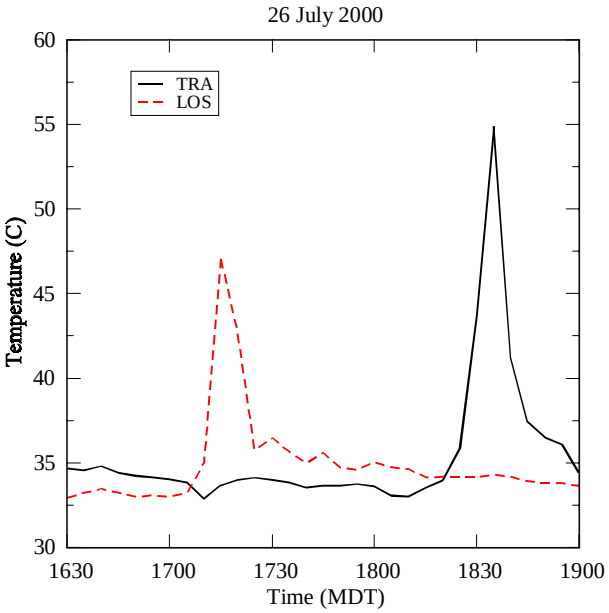
Meanwhile, the problems that have plagued the radar and sodar systems seem to have been minimized by the installation of a 25,000 BTU air conditioner. Of course, Murphy's Law prevailed when the air conditioner was first installed. As it turns out, the evaporator in the air conditioner had a hole in it. Since there was no other air conditioners available, parts had to be ordered and the unit was eventually repaired. Now that the air conditioner is working properly, the computers and electronics are working properly while temperatures outside of the trailer are almost always exceed 30 °C with afternoon temperatures and often approaching 35 to 38 °C for the maximum. (Jerry.Crescenti@noaa.gov, Randy Johnson, Neil Hukari, Shane Beard, and Tom Strong)

Cooperative Research with INEEL

INEEL Range Fire

The first major wildfire outbreak of the summer took place at INEEL on 26-29 July. Two fires were started by lightning on 26 July, and the INEEL Emergency Operations Center (EOC) was activated that evening. Both fires appeared to be under control by early the next morning, but one of them flared up again on the afternoon of the 27th, when the winds picked up to about 10 m/s. The winds also transported a third fire, which had started on adjacent Bureau of Land

Management land, to the southern boundary of INEEL. These fires were not fully contained until the 29th. FRD provided meteorological support in the EOC throughout the event. The fires also passed by two of the towers in the INEEL Mesonet. The plot below shows the 5-minute-average temperature at 2 m AGL during the period the fires passed the LOS and TRA towers. Both towers appear to have survived without damage. (Richard.Eckman@noaa.gov, Jeff French, Neil Hukari, Brad Reese)

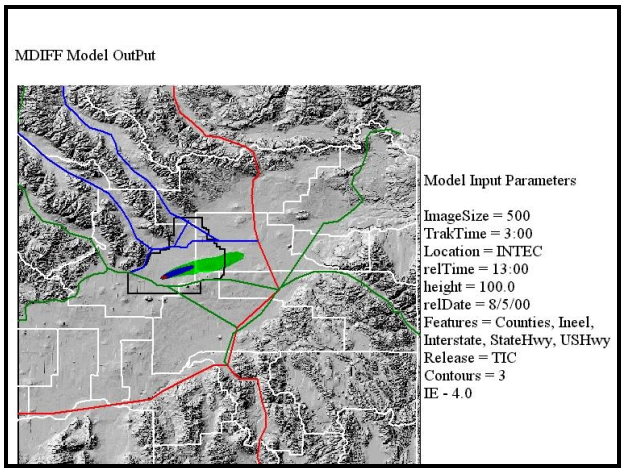


Wildfire modeling

Work is continuing on developing a wildfire modeling capability at FRD. The State of Idaho has developed a land-use map of the state with about 30 m resolution. A digital copy of this map has been obtained for possible use in developing a fuel map of INEEL. A programming library called fireLib, developed with support from the U.S. Forest Service, has also been obtained. This is a toolkit written in C that computes various parameters associated with surface fires. This toolkit could be useful in creating a fire model that relies on observations from the INEEL Mesonet for meteorological input. (Richard.Eckman@noaa.gov)

Web-Based MDIFF

To enhance our EOC products and capabilities, the MDIFF model is being modified to run through the Web. Significant progress has been made toward providing this capability. This will allow users in the EOC and elsewhere the capability of running dispersion models without a special client software. In addition, this reduces the amount of maintenance required from FRD staff to support the large number of INEELViz clients. The attached is a sample of the Web version of MDIFF with roads, the INEEL boundary and the counties displayed. (Brad Reese, brad@noaa.inel.gov)



DOE Meteorological Standards Document Released

A new standards document entitled *American National Standard for Determining*

Meteorological Information at Nuclear Facilities (ANSI/ANS-3.11-2000) has been approved and released by the American National Standards Institute. The Nuclear Utility Meteorological Users Group (NUMUG) and the Department of Energy (DOE) Meteorological Coordinating Council (DMCC) undertook comprehensive review of the previous standards document (ANSI/ANS-2.5) and recommended refinements in the following areas:

- Operational data applications (especially emergency preparedness) in addition to siting applications;
- Availability of guidance for both public and private sector entities;
- Life cycle considerations of meteorological monitoring systems;
- Addressing the need to monitor multiple locations to acquire sufficient data for models to characterize three-dimensional flows in complex terrain; and,
- Inclusion of state-of-the-art meteorological monitoring equipment, including remote sensing instrumentation.

Many meteorologists and engineers were instrumental (excuse the pun) in the development of this document. ARL representatives included John Irwin (ASMD), Darryl Randerson (SORD), and Jerry Crescenti. (Jerry.Crescenti@noaa.gov)

INEEL Mesoscale Modeling

MM5 forecasts for southeast Idaho are being run on a nearly daily basis at FRD. The focus is now shifting towards some validation work using observations from the INEEL Mesonet. The model still appears to be underestimating the peak afternoon wind speeds on many days, which is partly related to the problems with soil-moisture initialization discussed in the June activity report. One interesting event took place on 27 July when the wildfires at INEEL flared back up. The MM5 simulation on that day forecast a local area of stronger surface winds (about 10 m/s) right over INEEL. This was quite similar to the observed winds on that day. The official forecasts did not pick up on these localized stronger winds. The model also seems to have some skill in predicting precipitation over the nearby mountains. On 18 July, for example, the model forecast on the 3 km grid had convective storms developing during the afternoon over the mountains to the north and west of Idaho Falls. The outflows from these storms spread across the valley in the model, and were associated with northerly and northwesterly winds up to about 17 m/s. The actual sequence of events on that afternoon was quite similar to the simulation: satellite pictures clearly showed thunderstorm outflow boundaries moving out of the mountains and across the Snake River Plain. Strong northwesterly wind gusts were observed in Idaho Falls as the outflow passed. (Richard.Eckman@noaa.gov)

Other Activities

Model Validation Program (MVP)

As reported in past activity reports, an evaluation of the climatological turbulence algorithm used in the REEDM dispersion model was recently completed and published as a NOAA Technical Memorandum. In response to this report, the operational support staff at Cape Canaveral Air Station is looking at modifications to improve the algorithm's performance. They requested some of the data and programs used in the original evaluation, and these were sent via email attachments. REEDM is used operationally by the Air Force to model exhaust-cloud dispersion during rocket launches. (Richard.Eckman@noaa.gov)

11th Symposium on Meteorological Observations and Instrumentation

A tentative program has been constructed for the upcoming 11th Symposium on Meteorological Observations and Instrumentation (SMOI). A total of 112 abstracts have been submitted to the SMOI. Listed below are the session titles, number of papers in each session, the day and time as well as the session chairperson:

Session	Title	Papers	Day	Time	Chair
1	Calibration Methods, Quality Assurance and Quality Control Techniques	8	MON	8:00 am - 10:00 am	Robert A. Baxter
2	Sonic Anemometers and Extreme Wind Measurements	6	MON	10:30 am - 12:00 pm	Christopher A. Biltoft
3	Surface Energy Fluxes	6	MON	1:30 pm - 3:00 pm	Scott J. Richardson
4	Radiosondes and Rawinsondes	8	MON	3:30 pm - 5:30 pm	Daniel E. Wolfe
5	Aircraft Platforms and Airborne Measurements	14	TUE	8:00 am - 12:00 pm	Timothy L. Crawford
	Remote Sensing Lecture - Robert Cess, SUNY - Stony Brook	4	TUE	2:45 pm - 3:30 pm	Gennaro H. Crescenti
6	Meteorological Measurements in Harsh Environments	6	TUE	4:00 pm - 5:30 pm	Steven A. Cohn
P1	Grand Poster Night	22	TUE	7:00 pm - 9:00 pm	Gennaro H. Crescenti
7	Quality Assurance and Quality Control for Meteorological Networks	6	WED	1:30 pm - 3:00 pm	Scott J. Richardson
8	Rainfall, Water Vapor and Precipitable Water	6	WED	3:30 pm - 5:00 pm	Donald E. Lehrman

9	Radar Wind Profilers	8	THU	8:00 am - 10:00 am	Allen B. White
10	Satellite Measurements of Earth's Surface	6	THU	10:30 am - 12:00 pm	Matthew J. Parker
11	Clouds and Visibility	6	THU	1:30 pm - 3:00 pm	Matthew J. Parker
12	Solar Radiation	6	THU	3:30 pm - 5:00 pm	John J. DeLuisi

The following 12 papers are ARL contributions to the 11th SMOI (note ARL authors are in bold):

C. Bruce Baker, **T. P. Meyers**, and R. R. Heim, Jr. The precision and accuracy of the temperature measurements for the climate reference network.

T. L. Crawford, **R. J. Dobosy**, **D. L. Auble**, **G. H. Crescenti**, and **R. C. Johnson**. The Extreme Turbulence (ET) probe for measuring boundary-layer turbulence during hurricane-force winds.

K. L. Clawson, D. A. Johnson, and N. Z. Saliendra. Initial comparison of fluxes from Bowen ratio and eddy correlation instrumentation over a sagebrush steppe ecosystem.

R. C. Gilliam, **A. H. Huber**, and S. Raman. A study of diurnal and spatial variations of boundary layer parameters over Research Triangle Park, North Carolina.

T. L. Crawford, **G. H. Crescenti**, and J. M. Hacker. Small Environmental Research Aircraft (SERA): the future of airborne geoscience.

S. Brooks, **E. J. Dumas**, and J. Verfaillie, Jr. Development and testing of a Sky Arrow 650 environmental research aircraft.

C. Wayne Wright, and **J. R. French**. Comparison of aircraft attitude determination by GPS, INS, and airborne laser: preliminary results.

J. R. French, **T. L. Crawford**, and **R. C. Johnson**. A high-resolution temperature probe for airborne measurements.

W. P. Elliott, and **R. J. Ross**. Climate impacts of introducing Vaisala radiosondes in the U. S. observing network.

J. A. Augustine, **J. J. DeLuisi**, and C. N. Long. SURFRAD — A long-term research oriented surface radiation budget network for the United States.

R. C. Johnson, **R. G. Carter**, S. Businger, G. Barnes, and J. Businger. Improved smart balloon to better characterize hurricane boundary-layer inflow.

C. J. Nappo, and **D. L. Auble**. An electronic differential microbarograph system.

All but one of ARL's divisions are represented in the SMOI with most of the contributions from FRD. (Jerry.Crescenti@noaa.gov)

Robert Leviton Award

The AMS Measurements Committee, chaired by Jerry Crescenti, recently provided a critical review of four Journal of Atmospheric and Oceanic Technology papers written by students. The titles and authors of these papers are: *An electrodynamic levitation system for studying individual cloud particles under upper-tropospheric conditions* by R. A. Shaw, D. Lamb and A. M. Moyle; *High-resolution daytime cloud observations for northwestern Mexico from GOES-7 satellite observations* by J. Garatuza-Payan, R. T. Pinker and W. J. Shuttleworth; *Estimating the uncertainty in passive-microwave rain retrievals* by D. Coppens, Z. S. Haddad, and E. Im; and *Sidelobe contamination in bistatic radars* by R. de Elía and I. Zawadzki. The committee has made a recommendation to the AMS Awards Committee to bestow the Robert Leviton Award to one of these students. Unfortunately, the name of the winner can not be disclosed at this time until the AMS Awards Committee has formally approved of the Measurement Committee's recommendation. Last year the Robert Leviton Award was presented to Alison Grimsdell for her paper entitled *Convective boundary layer height measurement with wind profilers and comparison to cloud base*. (Jerry.Crescenti@noaa.gov)

Proposals

Determining Linkages Between Carbon Dioxide Flux and Ocean State Parameters by Gennaro H. Crescenti, Timothy L. Crawford, Douglas C. Vandemark, Tilden P. Meyers, Mark D. Dowell, and Wade R. McGillis, submitted to NASA Research Announcement NRA-00-OES-05.

Papers

Wright, C. W., J. R. French, 2001: Comparison of aircraft attitude determination by GPS, INS, and airborne laser: Preliminary results. *Eleventh Symposium on Meteorological Observations and Instrumentation*, Albuquerque, NM, Jan. 14-19, Amer. Meteor. Soc., abstract submitted.

Hacker, J. M., T. L. Crawford, and B. Neininger, 2000: Airborne monitoring of air quality using cost-efficient small aircraft combined with state-of-the-art sensor systems. *Seventh International Conference on Atmosphere Sciences and Applications to Air Quality*, Taipei, Taiwan, Oct. 31-Nov 2, abstract submitted.

Cote, Owen R., Jorg M. Hacker, Timothy L. Crawford, and Rongal J. Dobosy. 2000. Clear Air Turbulence and Refractive Turbulence in Upper Troposphere and Lower Stratosphere. *Aviation Range and Aerospace Meteorology Conference, American Meteorological Society, Orlando*, Florida, Sept. 11-15.

Papers Reviewed

Okin, G. S., and D. A. Gillette, 2000: Distribution of vegetation in wind-dominated landscapes: implications for wind erosion modeling and landscape processes. *J. Geophys. Res.*, ARL review by Jerry Crescenti.

Travel

Kirk Clawson visited Washington DC to for training and to meet with NOAA and USDA personnel, 5-12 July.

Tom Strong again went to California for the Central California Ozone Study the week of July 24. While there he did maintenance on the tower sensors and checked out the air conditioner at the Carrizo Plains site.

Tom Watson, who is currently on temporary assignment to the NOAA Policy and Strategic Planning Office in Washington D. C., returned to FRD the first week in July.

Visitors

Dr. Krzysztof E. Haman, Professor Institute of Geophysics, University of Warsaw

Dr. Owen R. Coté, Air Force Research Laboratory, Hanscom AFB, MA

Training

Kirk Clawson attended the Laboratory Safety and Environmental Management Conference in Alexandria, Virginia, July 11-12.

Personnel

Debbie Lacroix, who is filling the vacant Physical Scientist position created when Dianne Hoover retired, began her duties at FRD on July 16. Her first assignment involved bringing four gas chromatographs on line and calibrating them in preparation for the upcoming VTMX study. Debbie will be a real asset to the laboratory, and we are pleased to welcome her.